

**REMARKS:**

The preceding claim amendments and the following remarks are submitted as a full and complete response to the Office Action issued on March 9, 2009. Claims 8 and 11 have been cancelled without prejudice or disclaimer and claims 1 and 2 have been amended to incorporate the subject matter of claims 8 and 11, respectively. Claims 10 and 13 have been amended to have a proper antecedent basis in view of the amendments of claims 1 and 2. Claims 9 and 12 have been cancelled for the reasons explained below. No new matter has been added. Accordingly, claims 1-2, 4-7, 10 and 13 are pending. Reconsideration of all outstanding rejections is respectfully requested.

**Claim Rejections Under 35 U.S.C. §112**

The Patent Office has rejected claims 9 and 12 under 35 U.S.C. §112, first paragraph, as allegedly failing to comply with the written description requirement. Without acquiescing to the propriety of the Patent Office's position on this rejection, Applicants have cancelled claims 9 and 12, which renders this rejection moot. The cancellation of these claims has been made solely for the purpose of expediting the prosecution of this application and Applicants reserve the right to pursue the subject matter of claims 9 and 10 later in a continuation application. Withdrawal of this rejection is respectfully requested.

The Patent Office has also rejected claim 5 under 35 U.S.C. §112, second paragraph, as being indefinite, alleging that the recitation of claim 5 does not have a sufficient antecedent basis. Applicants have amended claim 5 so as not to require an antecedent basis. While claim 4 has not been rejected, claim 4 has also been

revised so as not to require an antecedent basis. Reconsideration and withdrawal of the rejection of claim 5 are respectfully requested.

**Claim Rejections Under 35 U.S.C. §103**

The Patent Office has rejected claims 1, 4, 6 and 8-10 under 35 U.S.C. §103(a) as allegedly obvious over Tian et al. ("Biometric Arrays of Oriented helical ZnO nanorods and Columns" JACS 2002, 124, 12954-12955) ("Tian"), in view of Boyle et al. ("Novel low temperature solution deposition of perpendicularly oriented rods of ZnO: substrate effects and evidence of the importance counter-ions in the control of crystal growth", Chem. Commun, 2002, 80-81) ("Boyle"). Claims 2, 5, 7, 11 and 13 have been rejected under 35 U.S.C. §103(a) as allegedly obvious over Tian, in view of Boyle and Ren et al. (U.S. Patent No. 7,294,417) ("Ren"). Applicants respectfully disagree.

As an initial matter, Applicants note that claims 1 and 2 have been amended to recite the subject matter of claims 8 and 11, respectively. That is, the revised claim 1 recites "a nutrient solution containing nutrients consisting essentially of hexamethylenetetramine (HMT) and at least one nutrient selected from the group consisting of Zn nitrate, Zn acetate and a derivative thereof." The revised claim 2 recites "a nutrient solution containing nutrients consisting essentially of sodium citrate and at least one nutrient selected from the group consisting of Zn acetate and a derivative thereof."

Thus, the nutrient solutions of claims 1 and 2 do not contain additional nutrients such as sodium citrate (in claim 1) or HMT (in claim 2). In contrast, the nutrient solution used in Tian contains both HMT (0.10M) and sodium citrate (0.0010M) together with Zn nitrate (0.030M). Nowhere does Tian teach or suggest

using a solution without sodium citrate (in claim 1) or HMT (in claim 2) as a nutrient solution for the growth of ZnO nanorod or ZnO nanowall. This is further substantiated by the Patent Office's arguments. The Patent Office contends that the first solution used in Tian, which contains Zn nitrate and HMT, is not a "nutrient solution," but a coating solution. The Patent Office further argues that the second solution of Tian, "which contains sodium nitrate, HMT and sodium citrate, is the only nutrient solution for the growth of ZnO nanorod." See page 9 of the Office Action (emphasis added).

Boyle does not cure this deficiency of Tian because the nutrition solution used in Boyle for the growth of ZnO rods contains additional chloride ions in addition to zinc acetate and HMT. Boyle teaches that "[t]he rationale behind the second step derives from the need to impede the propensity of ZnO crystallites to undergo basal twinning and to enhance the crystallinity and growth of ZnO rods" and that the additional chloride ion "appears to impede twinning." See col. 2 at page 81 (emphasis added). Thus, Boyle teaches or suggests that the chloride ions are required in the nutrition solution of the second step of the disclosed method. Nowhere does Boyle teach or suggest using a nutrition solution containing zinc acetate and HMT without any additional nutrients such as chloride ions. Thus, since both Tian and Boyle lacks any teaching or suggestion for modifying their disclosed nutrient solution, one skilled in the art would not have been motivated from the combined teachings of Tian and Boyle to use a nutrition solution as recited in claim 1 to grow ZnO nanoparticles to form a ZnO nanorod array with a reasonable expectation of success.

Ren has been further cited in the rejection of claim 2. However, Ren does not

cure the deficiency of the teachings of Tian and Boyle because it fails to teach or suggest a nutrient solution as recited in claim 2. Thus, even the combined teachings of Tian, Boyle and Ren would not have motivated the skilled artisan to use the nutrition solution as recited in claim 2 to grow ZnO nanoparticles to form a ZnO nanowall array with a reasonable expectation of success. Therefore, there is no *prima facie* case of obviousness established.

Even if there were, the unexpectedly superior results of the claimed method would sufficiently rebut the alleged *prima facie* case of obviousness. A perfectly oriented ZnO nanorod array can be obtained by using the method of claim 1. Fig. 3 is a powder X-ray diffraction pattern of a ZnO nanorod array formed on a Si-wafer using a nutrient solution containing 0.1M Zn nitrate solution and 0.1M HMT only as nutrients. Fig. 3 shows the [00 $\bar{l}$ ] peaks only without any of the  $[hk0]$  peaks, which evidences the perfect orientation of the ZnO nanorod. See lines 15-20, page 12 of the specification. In contrast, as shown in Fig. 1c of Tian, the ZnO nanorod prepared by the method disclosed in Tian is imperfectly oriented and has a helical structure. The ZnO nanorod with the perfect orientation is certainly unexpectedly superior results of the claimed method in view of the teaching of Tian which can produce only the ZnO nanorod that is imperfectly oriented.

With respect to claim 2, the nanowall array prepared by the method of claim 2 shows UV laser threshold of 5kw/cm<sup>2</sup> which is about 90% lower than the lowest threshold (40 kw/cm<sup>2</sup>) obtained in currently available nanorod arrays. See lines 5-8, page 16 of the specification. This very low threshold value is unexpected result of the method of claim 2 to one of ordinary skilled in the art.

Accordingly, the revised claim 1 would not have been obvious over Tian in

view of Boyle and the revised claim 2 would not have been obvious over Tian in view of Boyle and Ren.

With respect to the rejection of claim 4-7, 10 and 13, since these claims depend from the revised claim 1 or 2, they would not have been obvious over Tian in view of Boyle or further in view of Ren for the same reasons set forth with respect to claims 1 and 2. Accordingly, Applicants respectfully request reconsideration and withdrawal of all of the obviousness rejections.

In light of the foregoing, Applicants submit that all outstanding rejections have been overcome, and the instant application is in condition for allowance. Thus, Applicants respectfully request early allowance of the instant application. The Commissioner is hereby authorized to charge any fees or credit any overpayment to Deposit Account No. 02-2135.

Respectfully submitted,

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